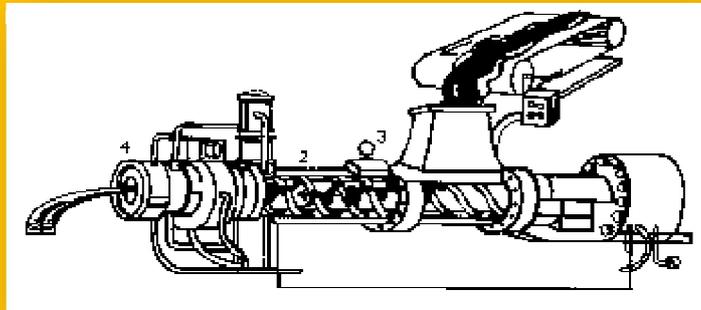


Processing of Rubber Materials

- Processing methods for rubber materials -
Extrusion - Machinery



R V Malik-CEO Malik Engineers, Mumbai, info@malikengg.com



Basic layout of the Rubber extruder



Cold feed extruder

The design of an extruder is shown in the sketch and consists of the following parts:

1. A barrel of varying size
2. The screw, which pumps the material towards the die
3. Extruder head containing the die
4. A feed cylinder, which helps to feed the material evenly into the extruder. This is also water cooled to bring down dangerously high

temperatures due to continuous working of hot rubber compound which usually comes directly from a Compounding Mill

5. A gearbox which reduce the speed of motor and builds up the torque necessary to put out material through the die
6. A drive motor

The size of extruders is given as the diameter of the screw. The number of screw diameters that can be placed along the screw, called the L/D ratio, determines the length of the screw and is a major factor in selection of extruder to match a certain process.

There are two main types of extruders, **hot feed** and **cold feed**. As the names imply, in one case the machine is fed with heated rubber compound from an open mill and in the other case with an uncured rubber slab or strip of ambient temperature.

The hot feed extruders represent the oldest technology and are not used to any great extent today. These extruders have short screws with L/D ratios between 4 and 8. This is due to fact, that, the Rubber having already been worked upon on the Mill with high temperature cannot be overworked in the Extruder further down. So Compression of materials is kept at minimum and L/D is short. The cold feed extruders representing the technology used today are considerably longer with a L/D ratio of 16 – 24 to permit more working of Raw Rubber stri to greater extent, for this reason the L/D and Compression is more compared to Warm Extruders. Cold Extruders also could be relied to have better controls over temperature and better product quality.

The longer screw ensures that the rubber material is sufficiently worked and heated before it reaches the die. To make it possible to regulate the temperature in the extruder, the wall of the barrel and the screw are equipped with channels in which water circulates for heating or cooling. The heating/cooling medium usually is pumped through a TCU (Temperature Control Unit) which maintains the Rubber temperature optimally.

The length of the barrel is divided into several sections and the temperature can be carefully controlled in each of the sections as well as in the screw.

In certain processes, air and even moisture that can occur in the rubber material must be ventilated or bled off. The extruder is then equipped with a vacuum zone (vented extruder) where the barrel has an extraction port with a vacuum pump applying a vacuum pressure. The screw has before the vacuum port worked the compound to a homogeneous state and to a temperature that permits gasification of moisture and other volatiles.

In order to increase the output from the extruder and to improve the quality of the extruded goods, several different types of screws have been developed. A common way is to change the pitch of the screw and with that the quantity of material which can be pumped through the extruder can vary accordingly. The screws are usually referred to as high or low capacity screws. So called mixing screws are one of these effective screw types.

Special types of extruder heads are used for extrusion of products with great width, i.e. tyre treads as well for covering reinforced hoses or cables with rubber. In the last case a so called crosshead is used, where the material to be covered with rubber is guided into a case in the extrusion head at a special angle towards the screw i.e. 90 ° and in that way being covered with rubber.

When extruding large profiles containing several different materials, again

like treads for car tyres, two or more pin extruders are often combined together in a manufacturing line. In such a line the different materials from each extruder are joined in the die at the end of the line to accomplish the final profile.

That technique called **Dual extrusion** is also used by manufacturing i.e. profiles with two different materials i.e. one black and one white compound or a cellular rubber combined with a solid rubber.



Dual or Co-Extrusion of Rubber

The drive motor on modern extruders is of the alternating current type or powered by alternating current with frequency changing, which both provide a simple methods of adjusting the speed of the screw.

When requirements with narrow tolerances and high precision on measurements have to be taken into account, a laser measuring gauge is a good aid for measuring the profile directly as it emerges from the die. The measurements are calculated in the control computer and are linked back to the driving unit, which regulates the speed to achieve correct dimension.

As the extruded part is further transported on a conveyer belt or take-up, the dimension regulation can even be obtained by controlling the speed of that belt. There are means for varying the speed of Conveyor belt also, for that reason.



Courtesy: Malik Engineers, Mumbai

Long Barrel Cold Feed Extruder

